MEDS Clinical Medicine (2022)
Clausius Scientific Press, Canada

DOI: 10.23977/medsc.2022.030406
ISSN 2616-1907 Vol. 3 Num. 4

Analysis of the Application of Esophageal Echocardiography-Guided Percutaneous Intervention for Atrial Septal Defect Closure

Jian Tang[1,2], Yaxiong Li[1,2], Fuqiang Li[1,2], Tao Li[1,2], Tian Chen[1,2], Mingliang Yan[1,2], Lueli Wang[1,2], Tianchen Zhang[1,2]

[1.] Dept. of Cardiovascular Surgery, Yan'an Hospital Affiliated to Kunming Medical University, Kunming, Yunnan, 650051, China
[2.] Yunnan Cardiovascular Surgery Institution, Kunming, Yunnan, 650051, China
413577226@qq.com

Keywords: Atrial septal defect, Transesophageal echocardiography, Interventional therapy

Abstract: Objective: To investigate the indications, methods, safety and efficacy of percutaneous interventional atrial septal defect closure under the guidance of transesophageal echocardiography. Methods: A total of 600 patients undergoing percutaneous interventional atrial septal defect closure under the guidance of esophageal echocardiography in our hospital from April 2017 to April 2021 were selected for retrospective analysis, and the preoperative and postoperative conditions were counted to evaluate the operation. completeness and validity of the formula. All operations were performed in the cardiac surgical operating room, guided by transesophageal echocardiography, under general anesthesia, transfemoral vein puncture to seal the atrial septal defect, and esophageal ultrasound was used to monitor the entire surgical process. All patients underwent re-examination of transthoracic echocardiography at 1 month, 3 months, and 12 months after operation. Results: 4 cases of intraoperative esophageal ultrasound showed that the mitral valve function was affected by the occluder (accounting for 0.6%), and the repair of atrial septal defect under cardiopulmonary bypass was timely transferred; 7 cases of poor shape of the occluder were corrected for the repair room under cardiopulmonary bypass. Septal defect (accounting for 1.1%); one case fell off to the descending aorta on the 3rd day after operation, and was then taken out under cardiopulmonary bypass in the hybrid operating room and repaired atrial septal defect (accounting for 0.16%). No adverse complication occurred during follow-up. The remaining 588 patients were successfully blocked by percutaneous intervention under the guidance of esophageal echocardiography (98%), of which 6 patients had residual shunts after surgery (1%), and the shunts were all less than 3 mm, and there was no serious short-term or long-term shunt. complication.

1. Introduction

Atrial septal defect is a common congenital heart disease, and current treatment modalities

include direct vision atrial septal defect repair and interventional occlusion, and interventional guidance modalities include percutaneous interventional occlusion under X-ray fluoroscopy and transthoracic/percutaneous interventional occlusion under ultrasound guidance [1]. Traditional surgery is effective, has a wide scope of application, and can be used to manage other intracardiac malformations simultaneously, but it is highly invasive and has a long recovery time. Interventional treatment is less invasive and has a faster recovery. The aim of this paper is to investigate the indications, methods, safety, and effectiveness of transesophageal echocardiography-guided percutaneous interventional closure of atrial septal defects.

2. Materials and Methods

2.1 General Information

A total of 600 patients with atrial septal defect and percutaneous interventional atrial septal defect closure guided by esophageal echocardiography from April 2017 to June 2018 were selected from the Department of Cardiac and Macrovascular Surgery, Yan'an Hospital, Kunming, China, of whom 251 were male patients and 349 were female patients, aged 32.2±13.4 years, weighing 13-80 kg. cardiac ultrasound status: all patients had central All patients had a central type secondary foramen ovale defect with an internal diameter of 17.9±6.2 mm, left-to-right shunt, no combined severe valvular lesions, and no combined remaining intracardiac malformations.

Inclusion criteria: age ⩾3 years; atrial septal defect of secondary foramen ovale type, with anterior and posterior margins of the defect, superior and inferior vena cava margins greater than 5 mm, and distance from the mitral valve greater than 5 mm; defect with left-to-right shunt, no severe pulmonary hypertension; no severe tricuspid insufficiency; no other combined intracardiac malformations. There were no peripheral vascular lesions or malformations.

2.2 Instruments and Materials

The Philips color Doppler echocardiograph was used for ultrasound, and the probe was a multiplanar transesophageal probe. The blocker adopts Shenzhen Centrin Heart atrial septal defect blocker, and the delivery system adopts Shenzhen Centrin SteerEase 45°delivery sheath.

2.3 Method

2.3.1 Preoperative Examination

Preoperative transesophageal echocardiography was performed to measure the diameter of the septal defect, the maximum septal diameter, the distance of the defect edge from the upper and lower vena cava, pulmonary veins and atrioventricular valve, the aortic root of the defect, pulmonary artery pressure and pericardial effusion, and the presence of other combined intracardiac malformations[2].All patients underwent routine preoperative laboratory tests, electrocardiogram, chest radiograph and transthoracic echocardiography.

2.3.2 Indications for Surgery[3]

1) Atrial septal defects that can be closed include patients with increased right heart load, or suspected paradoxical embolism, with pulmonary vascular resistance less than 2/3 of the body vascular resistance; for pulmonary vascular resistance greater than 8 Woods units, Eisenmenger's syndrome is already present and is a contraindication to closing the defect.

2) The defect is a secondary foramen ovale central septal defect with an internal diameter of 5

mm-35 mm. The edges of the defect are easily fixed with a blocker and the blocker does not affect atrioventricular valve function or body-pulmonary blood flow.

3)Patients weighing more than 10 kg may have a delivery sheath placed in the vessel. If the patient's weight is greater than 5 kg, transthoracic small incision atrial septal defect closure may be considered.[4]

2.3.3 Surgery Method

The patient underwent the procedure in the cardiac surgery suite with combined intravenous + inhalation anesthesia. After anesthesia, an esophageal ultrasound probe was placed. The blocking umbrella type and delivery sheath size were selected according to the defect size and margins. The right femoral vein was selected as the puncture point, followed by heparinization with heparin 1 mg/kg, and the blocker was selected (blocker diameter = maximum diameter of the atrial septal defect + 4 to 8 mm). The guide wire and sheath were placed under ultrasound guidance in the mid-esophageal biventricular vein section, and the sheath was sent through the atrial septum into the left atrium, switched to the short-axis section of the mid-esophageal aortic root, and the blocker was sent through the sheath into the left atrium, the left atrial umbrella of the blocker was opened, and the left atrial umbrella was pulled back so that it was close to the atrial septum, and the right atrial umbrella was released. The condition of the blocker was confirmed by ultrasound (push-pull test to determine the reliability of fixation), the function of the atrioventricular valve and the contact between the left umbrella of the blocker and the posterior mitral valve, and the pulmonary venous return. Afterwards, the blocker was released, the sheath was withdrawn and the puncture port was dressed with pressure (Figures 1-4). After the operation, the patient was returned to the ICU ward, and the tracheal tube was removed about 2 hours later, after which he returned to the general ward. Prophylactic anti-infective treatment was given postoperatively. Antiplatelet therapy with aspirin 3-5 mg/kg on the postoperative day, and if the blocker diameter was greater than 30 mm, two-combination antiplatelet therapy with aspirin + clopidogrel was given for a total of 6 months. The follow-up was 1, 3, and 12 months after surgery.

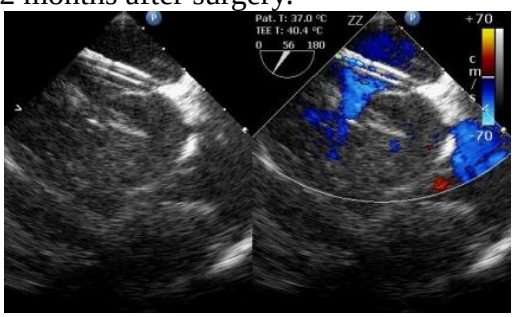

Fig.1 Mid Esophagus Guided by Double Vena Cava Section Sheath through the Interatrial Septum

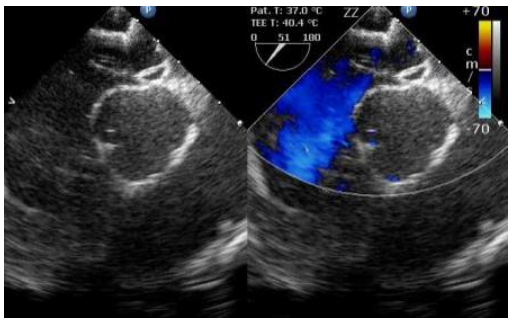

Fig.2 Release the Left Atrial Parachute and Pull Back to Tighten the Blocker Against the Atrial Septum

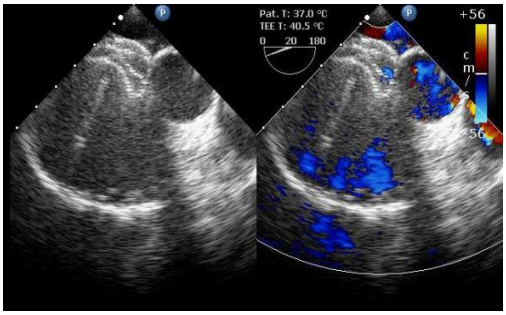

Fig.3 Pulling Test Confirms That the Blocker is Firmly Fixed

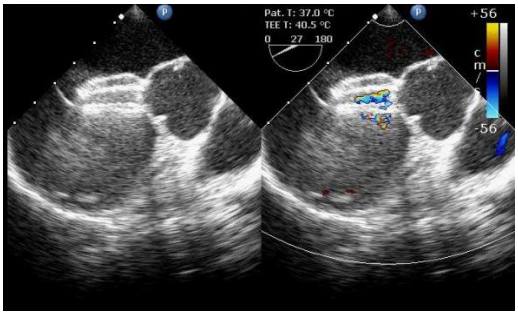

Fig.4 Release Blocker

3. Discussion

Since King TD reported the first case of interventional occlusion of an atrial septal defect in 1978,The 2020 European guidelines for the management of adult precardiac disease clearly state that interventional occlusion is the preferred treatment for patients with secondary atrial septal defects based on anatomic morphology (including diameters ⩽38 mm and stump margins of at least 5 mm (except for aortic stump margins)), when feasible, and many cardiac centers in China also consider interventional occlusion as the preferred treatment for atrial septal defects Many cardiac centers in China also use interventional occlusion as the preferred treatment for atrial septal defects. With the maturation of technology and the development of materials and equipment, interventional occlusion treatment has evolved from X-ray fluoroscopy-guided percutaneous occlusion to ultrasound-guided transthoracic occlusion and then ultrasound-guided percutaneous occlusion. However, when X-rays irradiate cells, due to various physical effects of X-rays, it can cause ionization of atoms or material molecules, leading to breakage of macromolecular chains and damage to cell structure. It may even induce mutations in genes and chromosomes, resulting in serious consequences such as miscarriage and fetal malformation in pregnant women. X-ray fluoroscopy-guided atrial septal defect occlusion has thus become limited in clinical practice; transthoracic occlusion is associated with postoperative surgical scars and pulmonary complications of open chest. In contrast, percutaneous interventional occlusion of atrial septal defects with esophageal echocardiographic guidance only requires echocardiographic guidance, avoiding radiation exposure and eliminating the need for chest opening, making the procedure less invasive and protecting health care workers. The technique is performed in the surgical suite, which shortens the time required to save patients from serious recent complications, such as pericardial tamponade, valve damage, and dislodged and displaced blockers, requiring open-heart surgery, and greatly increases the safety of treatment. Compared with transthoracic echocardiography, transesophageal echocardiography is more advantageous for guiding atrial septal defect occlusion. Although transthoracic echocardiography is often used in the early stage, it can improve image clarity, but

there is a false-positive diagnostic rate, and the number and size of defects cannot be accurately observed. In addition, echocardiography can clearly show the blood flow in the atrial septal defect, the position of the blocking parachute and the adjacent relationship with the surrounding tissue structures, especially whether there is an impact on the mitral valve leaflets, which has a significant advantage over chest X-ray. In addition, if the structure of the atrial septal defect is complex, transesophageal 3D echocardiography is more intuitive than transthoracic 2D echocardiography in the detailed assessment of the atrial septal defect, It is even possible to guide some patients with suitable conditions for single device occlusion of a double septal defect. Secondly, percutaneous atrial septal defect closure has lower operative time, tracheal intubation time, and hospital stay.

4. Conclusion

Our center completed 600 cases of esophageal ultrasound-guided interventional occlusion from April 2017 to April 2021, with 588 successful placements and a success rate of 98%. No complications such as dislodgement or displacement of the blocker, venous return obstruction, or pericardial compression were observed in the patients in the follow-up period, confirming the safety and effectiveness of the technique. However, no control group was included in this study, and only retrospective surgical experience and theoretical analysis were performed. More long-term follow-up results are still lacking, and a more comprehensive analysis and summary are pending after data accumulation.

References

[1] PAN Xiangbin, PANG Kunjing, Ouyang Wenbin, et al. Clinical analysis of transthoracic echocardiography-guided interventional treatment of atrial septal defect alone. Guangzhou, Guangdong, China: 20142.

[2] Liu YL, Dai RP, Wang H, et al. Study of transesophageal echocardiography-guided atrial septal defect sealing treatment. Chinese Journal of Cardiovascular Diseases, no.01, pp.15-17, 2001.

[3] Zhu Xiangyang. Chinese Expert Consensus on Interventional Treatment of Common Congenital Heart Diseases I. Interventional Treatment of Atrial Septal Defects. Journal of Interventional Radiology, no.01, pp.3-9, 2011.

[4] Hu, Shengshou, Pan, Xiangbin, Chang, Qian. Expert consensus on interventional treatment of common cardiovascular diseases via surgical route. China Circulation Magazine, no.02, pp.105-119, 2017.